COOLING UNIT FOR A DRINKING WATER FOUNTAIN, AND WATER FOUNTAIN CONTAINING SUCH A UNIT.

The present invention relates to a cooling unit for drinking water fountains, and fountains containing such a unit.

Drinking water fountains are known generally in the art, and many systems have been commercialised for a long period of time. Most drinking fountains can be classed into one of two types : mainline water supplied drinking fountains, or bottled water fountains. Most of the drinking water fountains manufactured today have a cooling unit that enables water in the fountain to be chilled before being dispensed, and possibly also a heating unit in order to provide warm or tempered drinking water to the user. The cooling units on most drinking water fountains involve a system of heat exchange with an evaporator coil that chills a thermal exchange liquid and then this chilled thermal exchange liquid is pumped around a separate coil through which the water to be chilled is circulated. As the warmer drinking water passes through the coil containing the thermal exchange liquid, heat energy is transferred by conduction from the drinking water to the thermal exchange liquid, and in this way the drinking water becomes cooler.

The current configuration of most cooling units in drinking water fountains is rather complex, and this does not make them easy to maintain, or clean. Furthermore, each drinking water fountain is generally designed in such a way that it is very difficult to replace one cooling unit with another from a different manufacturer, which also makes maintenance more costly, and very much dependent on the initial manufacturer of the fountain.

The present applicants have sought to overcome these problems by providing a self-contained cooling unit designed in such a way that it is both easy to maintain, clean, and also be capable of being installed in other manufacturers' drinking water fountains. Such a self-contained cooling unit therefore opens up a whole range of water fountains that may be ageing, or in need of repair, and which can be easily converted to function with the self-contained cooling unit of

the present invention.

Accordingly, one object of the present invention is a self-contained cooling unit for drinking water fountains, wherein the cooling unit comprises :

- an outer casing forming a fluidtight chamber ;
- a thermal exchange fluid held within the chamber ;
- a source of cold energy transferable to the thermal exchange fluid ;
- at least one drinking water conduit arranged within the chamber and having a drinking water inlet and a drinking water outlet outside of said chamber.

In a preferred embodiment of the invention, the fluidtight chamber holding the thermal exchange fluid is divided into two sub-chambers, an inner sub-chamber being contained within an outer sub-chamber. In another preferred embodiment, the outer sub-chamber substantially surrounds an upper zone of the inner sub-chamber, more preferably an upper third of the inner sub-chamber, and most preferably an upper half of the inner sub-chamber. It has surprisingly been discovered by the applicants that the advantage of this particular embodiment is that if a drinking water conduit is arranged in the upper, outer sub-chamber, around the inner, lower sub-chamber, then it is possible to reduce the amount of conduit material necessary to obtain the same cooling effect, i.e. the same drop in temperature of the water, as is traditionally obtained with much longer water conduits, which in turn has a direct impact on manufacturing costs because less conduit material is used. In such an embodiment, the floor of the outer sub-chamber is accordingly most preferably located at about half the height of the inner lower sub-chamber. This design is therefore not only energy efficient, and economical to produce, but also mechanically robust, since the longer inner sub-chamber is reinforced at mid-height by the floor of the outer sub-chamber. One will easily understand from the above that the outer, upper sub-chamber, and inner, lower sub-chamber are essentially axially aligned, similar to a concentric circle arrangement. It is nevertheless possible, and even in some instances preferred, that a vertical axis of the inner, lower sub-chamber be displaced horizontally with respect to a vertical axis of the outer, upper sub-chamber, such that the

axes remain parallel, whilst the inner, lower sub-chamber still remains within the diameter of the upper, outer sub-chamber. Another advantage of the arrangement of sub-chambers as described above according to the preferred embodiments of the invention is that the self-contained cooling unit is very compact, and can even be made to fit into a relatively small volume such as that present in cooled water dispensers that use a bag system for temporarily storing the drinking water during the cooling operation. Bag systems of this type are known for example from EP 0 581 492 in the name of EBAC Ltd. The problem with these bags is that they must be changed frequently due to potential bacterial build-up, blockage of the small diameter feed tubes, and the like. At present, these bags are simply thrown away and replaced with new ones, but this procedure is not only costly over time, but is also rather complicated and fiddly, even for experienced maintenance personnel. With the integrated cooling unit according to the present invention however, these problems are obviated, since the integrated cooling unit can be used for a longer period of time without requiring maintenance, or without having to necessitate an awkward change of bags. Indeed, since the unit is essentially sealed, except for the water conduit inlet and outlet, which are connected to the drinking water source and the dispenser taps respectively, the thermal exchange fluid with the unit is essentially protected from outside bacterial infection.

In still yet another preferred embodiment, the thermal exchange fluid is provided with at least one flow passage within the chamber for flow of the thermal exchange fluid within the chamber. Even more preferably, the at least one flow passage allows thermal exchange fluid to flow from the outer sub-chamber to the inner sub-chamber and vice-versa.

Preferably, the at least one drinking water conduit is located in an outer sub-chamber of the chamber. Alternatively, and in another preferred embodiment, the at least one drinking water conduit is located in an inner sub-chamber of the chamber. In either case, the drinking water conduit is preferably arranged within the chamber as a coil. The drinking water conduit is preferably made of a material that readily transmits energy by conduction to its contents, i.e. the

drinking water circulating therein. Such materials are generally made of metal, such as copper, although stainless steel is the preferred metal to use. One particular advantage of using a metal such as stainless steel for the water conduit material is that it becomes possible to sanitize the system by application of an electric current to the conduit. In addition, the water conduit preferably has a regular undulating cross-section, in other words, the conduit is corrugated, which significantly increases energy transfer efficiency between the thermal exchange fluid, the surface of the conduit and the water contained therein, thereby also allowing the use of much smaller conduit cross-sections, and shorter lengths of such conduits in any given system, since the same equivalent transfer of energy can be obtained with less material.

In one preferred embodiment, the source of cold energy transferable to the thermal exchange fluid is located on an external wall of the chamber, and most preferably, the source of cold energy transferable to the thermal exchange fluid is located on an external wall of the inner sub-chamber. In another preferred embodiment, the source of cold energy transferable to the thermal exchange fluid is located within the inner sub-chamber of the chamber, and in a particularly preferred alternative embodiment, said source of cold energy transferable to the thermal exchange fluid is located within an exterior cavity formed by a wall of the inner sub-chamber.

The sources of cold energy that can be used in the cooling unit of the present invention are multiple and various. In one preferred embodiment, the source of cold energy transferable to the thermal exchange fluid is a Peltier plate. In yet another preferred, but different embodiment, the source of cold energy is a dielectric cooler. In still yet another preferred embodiment, the source of cold energy is an evaporator coil placed within an inner sub-chamber of the chamber.

In one particularly preferred embodiment, an insulating material is provided on one side of the chamber between the source of cold energy located on an external wall, and the external wall of the chamber. This prevents that side of the chamber from becoming too cold, and thereby avoids the problem of the

thermal exchange fluid changing phase from fluid to solid.

In still yet another preferred embodiment, the self-contained cooling unit further comprises a temperature sensor located within the chamber. The sensor is chosen for its ability to not only monitor the temperature, and send according signals to increase or decrease cold generation, but can also detect a phase change in the thermal exchange fluid and send an appropriate signals to control this.

In terms of thermal exchange fluids, many are known to the skilled person, and do not need to be mentioned here. For the purposes of the present invention, water is the preferred thermal exchange fluid, because of its ability to form ice within the chamber that generates even more cold than the thermal exchange fluid.

Brief Description of the Figures

Figure 1 is a cross-sectional view of a first preferred embodiment of the self-contained cooling unit for drinking water fountains according to the present invention.

Figure 2 is a cross-sectional view of a second preferred embodiment of the self-contained cooling unit for drinking water fountains according to the present invention.

Figure 3 is a cross-sectional view of a preferred device similar to the device of Figure 2.

Figure 4 is a cross-sectional view of still yet a further preferred embodiment of the device of the present invention.

Figure 5 is yet another preferred embodiment of the device of the present invention.

Detailed Description of Preferred Embodiments

The following description in association with the Figures is merely exemplary and serves to illustrate some of the most preferred embodiments of the present invention.

Figure 1 shows a cross-sectional representation of a self-contained cooling unit according to a first preferred embodiment. The unit is indicated generally by the reference number 1, and comprises an outer casing 2 forming a fluidtight chamber, having a top closure 3 and a bottom closure 8. The chamber is subdivided into two sub-chambers, an outer sub-chamber 5, and an inner sub-chamber 7, located within the outer sub-chamber 5. The outer 5 and inner 7 sub-chambers are defined by an outer wall 4 and an inner wall 6 respectively, whereby the space between the outer wall 4 and the inner wall 6 corresponds to the outer sub-chamber 5, and the inner wall 6 is continuous and generally circular in circumference, thereby defining a space inside of the circumference that is the inner sub-chamber 7.

The self-contained cooling unit of this embodiment also comprises a drinking water conduit 11 arranged in a coil within the outer sub-chamber 5, and having a drinking water inlet 9 and a drinking water outlet 10 connected to the drinking water conduit, but located outside of the chamber. The unit is also equipped with a temperature sensor 12, that projects down from the top closure 3 into the inner sub-chamber 7. The temperature sensor 12 is covered with an insulating sheath material 13 along most of its length, except for the tip. The sensor is capable of detecting not only fluid temperatures, but can also check for the presence of phase change with the inner sub-chamber. Both the inner 5 and outer sub-chambers are filled with the same thermal exchange fluid, for example water (not shown). The thermal exchange fluid can flow from one sub-chamber to the next via at least one flow passage within the chambers 5, 7. The water used as thermal exchange fluid and held within the chambers, is circulated between the inner and outer sub-chambers 5, 7, via a pump 14 arranged on the side of the unit, which pump takes thermal exchange water from the inner sub-chamber 7 and pumps it through a passage 16 back into the outer chamber 5. In this way, thermal exchange fluid is caused to flow up the side of the outer sub-chamber 5 around and over the water conduit 11, and then over the top of the inner wall 6 to fall down from the top of the unit into the inner sub-chamber 7. Pump 15 is provided adjacent to a passage 17 to enable the thermal exchange fluid to be pumped out, either permanently or

temporarily, and then be pumped back into the chamber via passage 17.

The inner sub-chamber 7 houses a source of cold energy that is transferable to the thermal exchange fluid. In the currently preferred embodiment, the source of cold energy is an evaporator circuit 18 that is held within the inner sub-chamber such that cold energy is dissipated into the thermal exchange fluid, in this case, water, and then this water is pumped around the chamber out of the inner sub-chamber 7, and into the outer sub-chamber 5, as explained above. As the evaporator charges the water with cold energy, ice crystals tend to form in the inner sub-chamber 7, and this adds to the cooling effect on the water that is the thermal exchange fluid. Consequently, when the unit is in operation, the chilled thermal exchange fluid is circulated over and around the drinking water conduit 11, resulting in chilling and cooling of the drinking water in the conduit 11. After having entered the system by inlet 9 in an unchilled state, the drinking water will exit the system via outlet 10, and have been chilled in the process.

Turning now to Figure 2, in this preferred embodiment of the self-contained cooling unit, elements that are the same as in the previously described embodiment with respect to Figure 1 have been given the same reference numerals. The unit still comprises a chamber having two sub-chambers, one outer sub-chamber 5, and one inner sub-chamber 7, defined by an outer wall 4, and an inner wall 6. This time however, the drinking water conduit 11 is arranged in a spiral in the inner sub-chamber 7. The outer wall 4 receives an insulating coat 21, for example of silicone rubber, or polystyrene that is affixed to the outward face of outer wall 4 on one side of the unit. An evaporator coil 19 extends around the whole periphery of the outer wall 4, and on the side of the unit that does not have the insulating coat 21, the evaporator coil 19 touches the outer wall 4 to transmit its cold energy to the outer sub-chamber 5 via conduction, and then through the outer wall 4 via conduction into the chamber 5 containing the thermal exchange fluid. In operation, the cold energy transmitted by conduction causes the thermal exchange fluid to change phase and become a solid, i.e. in the case where water is the thermal exchange fluid, to make an ice block 20. The ice block 20 further imparts a chilling effect to the

remainder of the thermal exchange fluid. This fluid is present in both sub-chambers, and is circulated between the inner sub-chamber 7 and the outer sub-chamber 5 by means of a passage 22 leading to a pump 24, equipped with rotors 25. The rotors 25 of the pump 24 expel the chilled thermal exchange fluid into the bottom of the outer sub-chamber 5 via an outlet 23 located in the bottom of the outer sub-chamber 5. In this way, chilled thermal exchange fluid flows from the top of the outer sub-chamber 5 into the top of inner sub-chamber 7 and down over the drinking water conduit 11, thereby cooling the drinking water. Additionally, the inner sub-chamber 7 can be fitted with an outlet 26, that enables the cooling unit to be drained of thermal exchange fluid should that be necessary, for example for cleaning and maintenance, and also provides a convenient way of being able to reintroduce said thermal exchange fluid back into the chamber again once these operations have been carried out. This can be done for example, by providing a bin into which the thermal exchange fluid is pumped via outlet 26, using a separate pump, where the bin can be located above the cooling unit in another part of the water fountain.

The preferred embodiment of Figure 3 is similar to that of Figure 2, and the references have been retained where the elements of the unit are the same. The major difference between the embodiment of Figure 3 and that of Figure 2 is that the self-contained cooling unit of Figure 3 has been designed to fit in a much smaller useful volume, such as is to be found in certain water fountains that use a bag system for distributing water. In this case, the cooling unit needs to be dimensioned according to the corresponding dimensions of the bag, i.e. relatively narrow, and relatively long. Consequently, the coils of the drinking water conduit have been made tighter in order to fit into a smaller volume and still offer sufficient surface contact for the thermal exchange fluid, which is partly frozen as ice in outer sub-chamber 5, to contact the drinking water conduit and ensure adequate cooling.

The preferred embodiment of Figure 4 shows yet another way in which the self-contained cooling unit can be arranged. This unit is similar to that described previously in the description with respect to Figure 1. The only differences here are that :

- the source of cold energy transferable to the thermal exchange fluid is an evaporator 27 contained within a ceramic shell. Such ceramic shells evaporators are known in the art per se to the skilled person, and do not require further description here ;
- the ceramic shell evaporator 27 is inserted in a sealingly engaging manner into an exterior cavity 30 formed by a wall 29 of the inner sub-chamber 7.

As can be seen, this arrangement also makes it easy to change or replace the ceramic shell evaporator 27, should that ever be necessary. The shape of the exterior cavity 30 formed by the wall 29 of the inner sub-chamber 7 substantially corresponds to the peripheral shape of the ceramic shell evaporator 27, such that introduction of the latter into the former leads to an elastically gripped and engaged seal between the two. Alternatively, the ceramic shell evaporator can be replaced by a Peltier plate insert into the exterior cavity. Peltier plates will be discussed in more detail below with respect to Figure 5.

In a still yet further preferred embodiment, as illustrated in Figure 5, the same basic unit is modified in that the source of cold energy transferable to the thermal exchange fluid is a Peltier plate 31. These are known to the skilled person as such and do not need to be described further. The Peltier plate 31 is attached or affixed to the outside of the wall 6 of the inner sub-chamber 7, preferably towards the bottom 8, and the temperature sensor 12 is extended down from the top 3 of the chamber so that the tip of the sensor is substantially in alignment with the middle of the Peltier plate 31. In this way, the temperature sensor can more precisely control the degree of cold energy generated, and any ice build-up within the chamber.

The above examples are merely representative of some preferred embodiments of the invention are not intended to limit the spirit or scope of the invention.